Discussion Ideas

LAr TPC Reconstruction Assessment workshop - Fermilab
October 19th, 2015
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- Next steps to answer LBNC questions
- Define “automated” reconstruction means. Split in different categories of objects to be reconstructed/different experiments needs
  - tracks reco (MIP, low energy tracks)
  - shower reco
  - vertex reco
  - different detectors (electronics readout etc.), ν beam energy
  - different type of events, different backgrounds
- On surface detectors: cosmic ray tagging and removal
- Charged particle beam events
- Neutrino event reconstruction:
  - Filter to select different samples (ν_μ, ν_e, NC, CC, exclusive channels etc.)
- Low energy events (SN ν events)
- Need for visual scanning and “semi-automated” reconstruction

LBNC request post the reconstruction workshop

D. MacFarley

- Ambitious: will take time and effort beyond these two days!
- A comprehensive summary of the current status of and future plans for further development of automated reconstruction efforts:
  - Basic physics information, such as event classes and topologies, backgrounds for each experiment, performance requirements, etc.;
  - Current state-of-the-art, including quantified performance of the reconstruction;
  - Leadership for the current effort and the level of effort across the collaboration;
  - Degree to which the effort relies on common software tools, such as analysis framework development, etc. and their further development;

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- Timeline, milestones, deliverables and level of effort required for further development;
- Linkages to hardware system development and experience with neutrino and test beam data
- Assessment of areas of commonality with other SBN or LBN experiments; and
- Assessment of resource limitations and impact of bringing additional targeted help, either from Fermilab or in cooperation with other science collaborations.

- Workshop should consider mechanisms for sharing the results of development progress on a more continuous basis
  - e.g., though an ongoing joint steering committee, a regular forum for exchange on development progress, and/or future more extensive workshop devoted to LAr reconstruction

ArgoNeuT

Lessons Learned

- High efficiency in reconstructing MIP particles.
- Need to improve efficiency to reconstruct low energy tracks.
- Vertex reconstruction is important for both track and shower reconstruction.
- Overlapping tracks are hard to reconstruct.
  - Include calorimetry information in tracking.
- Difficulty with 2 planes.

ICARUS

Conclusions

- Exposed in Gran Sasso underground Lab. to CNGS neutrino beam, the ICARUS T600 neutrino experiment with 760 ton of highly purified LAr has successfully completed a three years physics program at LNGS: 2650 neutrino interactions (7.93 10^{19} p.o.t.) have been studied in details and 7 ν_e have been identified.
- The ICARUS collaboration has developed during many years a complex system of tools for event display, scanning, reconstruction and analysis;
- Extensive T600 experience allowed us to develop, debug and tune algorithms in a real large-scale experiment environment;
- Visualization and interface with physicist are crucial functionalities for a detailed study and identification of the ν interaction and for the validation and improvements of the reconstruction;
- The relatively small number of interesting events allowed a semi-automatic approach in the analysis: while some parts of basic reconstructions are automatized, the general event classification and particle selection was left to human scanners.

Summary

MicroBooNE

- MicroBooNE presently has several areas of focus
  - Data driven areas:
    - Developing signal processing algorithms to help mitigate the effects of the noise currently in the raw data stream
    - Improving the ability of the pattern recognition and tracking algorithms to handle dead channel gaps
  - Monte Carlo driven areas:
    - Improving the shower reconstruction with the current primary focus to improve both the efficiency and resolution of the pi-zero reconstruction
    - Improving the track fits to address issues with the track start point, angular resolution and energy reconstruction
    - Developing end-to-end analyses with the goal of providing feedback to further needed improvements in reconstruction
- One cannot emphasize enough the importance of developing end to end analysis chains to provide feedback to reconstruction

CONCLUSIONS

LArIAT

- Most difficult part of getting reconstruction to work: modifying data structure to accommodate LArSoft expectation of what an event is

  Solved. We "sliced" our data into LArSoft-manageable chunks
- Deconvolution

  Works fairly well, especially since Tingjun tuned to LArIAT data
- Hit Finding

  Works well
- Clustering

  Tuning may improve cluster-splitting efficiency for small kinks

  Usually identifies reasonable clusters

  Sometimes misses obvious tracks (rarely)
- Tracks & Showers

  PM tracking algorithm works very well, other tracking algorithms work ok

  Shower-finding runs without crashing, but not yet producing anything
- Calorimetry

  Working ok, but needs more tuning